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Date of request 10/12/95 Expected receipt of document 6/14/96 ~~7/14/96~~

Document number KSA-231 Date of document 2/26/60

Title and author (if document is unnumbered) KSA-231
Cascade Feed Withdrawal Facilities Nuclear Safety Summary

⇒ copy marked document

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Folder 5.3
 Critical Hazards
 Program (1960)

Date request received 6/19/96

Date submitted to ADC 7/8/96

Date submitted to HSA Coordinator 6/19/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/8/96 8/2/96

Date received from CICO 7/31/96 8/7/96

Date submitted to ChemRisk/Shonka and DOE 8/7/96

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 Mr. K. M. Jones

Date

February 26, 1960

Originating Dept.

Answering letter date

Cascade Feed and Withdrawal
Facilities - Nuclear Safety
Summary - Revision No. 2

Copies To:

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(level and category)

SJMcL 1/21/96

APC or ADP signature (first reviewer) Date

J.D. Thornton 7/30/96

APC signature (final review) Date

The attached tabular summary outlines our understanding of the provisions of the criticality approval letters presently in effect for the Oak Ridge Gaseous Diffusion Plant feed and withdrawal facilities, and thus indicates the current status of the operation and equipment controls for nuclear safety in these facilities. Operational or equipment changes which have been made since the latest summary¹ was issued are included in this revision.

Basic equipment for routine withdrawal of enriched uranium materials from the cascade has been designed within the ORGDP concepts² of safe geometry; however, special side withdrawals in geometrically unsafe units have been considered where adequate operational controls are in effect to maintain weight, U-235 enrichment, and moderation within predetermined limits. Similarly, UF₆ feed material is vaporized to the cascade in cylinders of safe diameter, or in cylinders of unsafe diameter but individually containing a safe quantity. All items of equipment, including cylinders in designated feed, withdrawal, or storage positions, and including units moving along predetermined paths, are spaced to meet current ORGDP interaction criteria.²

The plant cold trap facilities which may be used for withdrawal operations have been previously considered.³ It may be noted, however, that all cold trap

This document has been approved for release to the public by: *Davy S. Hilliard*
Date: *8/8/96*
Technical Information Officer
Oak Ridge K-25 Site

Henry, H. F., Cascade Feed and Withdrawal Facilities - Special Hazards Summary - Revision No. 1, 10-31-56 (KSA-64)

2 Henry, H. F., Mallett, A. J., Newlon, C. E., and Pryor, W. A., Criticality Data and Nuclear Safety Guide Applicable to the Oak Ridge Gaseous Diffusion Plant, Revision 5, dated 10-31-56 (KSA-119, Fifth Revision)

Henry, H. F., Cascade Cold Trap Facilities - Nuclear Safety Summary - Revision 1, dated 10-31-56 (KSA-143)

Union Carbide Nuclear Company, Oak Ridge
Gaseous Diffusion Plant, Operating Contractor
for the U.S. Atomic Energy Commission.

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- DECLASSIFIED -

by authority of: JF Preston, Classification Specialist
(CG-PGD-5) K-25 Site Classification Office

7/30/96
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or

John J. Preston notice memo, TIC notice, 8/31/96
Person making change John J. Preston 8/31/96
(Document identification verified by) _____
(date) 8/31/96

facilities, with the exception of those in K-31 and K-33, have been placed in stand-by and will be used only for emergency conditions.

It is requested that the ORGDP Nuclear Safety Department be advised by supervision concerned if the specified controls or other information given herein are not in agreement with existing operations.

W. A. Johnson:AJM:vr

Hugh F. Henry
H. F. Henry
Safety, Fire, and Radiation Control

NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY			OPERATIONAL CONTROLS
			DESIGN CYL. VOL.	OPERATIONAL LIMITS SLAB VOL.	ASSAY CONC.	
A. K-25 Location	<p>Continuous removal from the top of the cascade of product UF₆ and residual C₈F₁₆ coolant by means of selective cold trapping, and the separation of these components by fractional distillation.</p> <p>KSA-221 (N) KSA-214 (N) KSA-79 (N) KSA-47 KS-502 KS-498 KS-459 KS-425</p>	<p>Freeze-out equipment:</p> <p>18 - 5" I.D. x 36" tanks, each frozen refrigerated, electrically heated for liquid UF₆ draining, and enclosed in a double-walled 10" I.D. x 41" container. This container is equipped with a 1" I.D. drain line containing a solenoid valve for temperature control which opens automatically on the heating cycle.</p> <p>Distillation equipment:</p> <p>1 - 3" I.D. x 16' distillation column.</p>	x			<p>A. K-25 Location</p> <p>1. K-306-7 UF₆ Withdrawal Facility</p> <ul style="list-style-type: none"> a. Coolant pressures in the condenser unit are maintained above process pressures. b. Cylinders are transferred singly on the monorail or in dollies along specified routes and temporarily stored in either the fixed pipe sections or in these dollies in specified locations. c. Contaminated materials are removed in geometrically safe containers which are transferred in dollies along prescribed routes to designated storage or recovery facilities.

(N) New Approval Letters

NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY		OPERATIONAL CONTROLS	
			DESIGN CYL. VOL.	OPERATIONAL LIMITS SLAB VOL.	ASSAY CONC.	ASSAY CONC.
1. K=306-a7 UF ₆ Withdrawal Facility (Cont.)		<p>Electrically heated housings are provided for the freeze-out and distillation equipment and for the UF₆ withdrawal cylinders; these housings are supplied by a dry-air bleed, monitored by a UF₆ release alarm system, and equipped with a common manually operated evacuation system consisting of:</p> <ul style="list-style-type: none"> 1 - 100 psig. air ejector. x 6 - 5" I.D. x 6½" alumina traps separated by spacers. x 1 - UF₆ or C₈F₁₆ flash-back unit consisting of an electrically heated housing equipped to handle 1 - 5" I.D. x 30" cylinder. x <p>(Each heated housing has a base section of sufficient area such that a liquid depth below 1½" will be maintained in event of leakage of liquid UF₆ or C₈F₁₆ from the enclosed equipment.)</p> <p>Fixed 6" I.D. x 2' vertical pipe sections separated by spacers provided for temporary cylinder storage; monorail and product dollies are provided for cylinder transfer.</p>		x	x	x

NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	METHOD SUMMARY			OPERATIONAL CONTROLS
			DESIGN	OPERATIONAL LIMITS	ASSAY CONC.	
CYL. SLAB VOL.	MASS	ASSAY CONC.				
2. K-305-9 Withdrawal Facility KSA=230 (N) KSA=214 (N)	Withdrawal from the top of the cascade of product UF ₆ . (This unit is currently being used intermittently on an experimental basis and may eventually replace or augment the K-306-7 facility. See A-1.)	6' - mobile mechanically refrigerated withdrawal units in a row, each equipped to solidify UF ₆ in a 5" I.D. x 30" cylinder. These units are connected to the cascade at the line recorder facility.				2. K-305-9 Withdrawal Facility a. Cylinders are removed singly from the withdrawal units and are maintained at least 1' from the tops of the other units while being moved on the monorail.
3. K-101 C ₈ F ₁₆ Coolant Withdrawal Facility*	Component separation of UF ₆ -C ₈ F ₁₆ mixtures by fractional distillation. These gas mixtures are routed directly from the cascade at K-303-1 to K-101 where the C ₈ F ₁₆ is removed as a liquid; the gaseous UF ₆ is returned to the cascade at K-302-5. KS-305 KS-264	1 - size 38 centrifugal pump equipped with a size 2 aftercooler. (Located at the K-303-1 intersectional cell.) 1 = 6.25 cfm. Worthington reciprocating compressor. Seal exhaust gases from this pump evacuated through	Gas phase operation	Gas phase operation	Gas phase operation	3. K-101 C ₈ F ₁₆ Coolant Withdrawal Facility* a. Coolant pressures in the condenser unit are maintained above process pressures. b. Cylinders are filled singly and are placed in dollies for transfer and storage.
		1 - Welch vacuum pump. 1 - 5" I.D. x 42" alumina trap.	x			
		1 - distillation tower made up of the following components: 1 - 5" I.D. x 24' distillation column. 1 - 6" I.D. x 3' reboiler equipped with electric heaters. 1 - 5" I.D. x 4' reflux drum.	x	x	x	

* This unit is in stand-by.

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NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY			OPERATIONAL CONTROLS
			DESIGN CYL. VOL.	OPERATIONAL LIMITS MASS	ASSAY CONC.	
3. K-101 C ₈ F ₁₆ Coolant Withdrawal Facility (Cont.)		1 - 5" I.D. x 10' reflux condenser (not enclosed in housing), cooled by C ₈ F ₁₆ . Instrumentation same as A-1.	x			
		The distillation column is enclosed in an electrically heated housing; the base-section area of this housing is designed to maintain a liquid depth below 1 ¹ / ₂ " in event of leakage. (See A-1.)	x			
		UF ₆ release alarm and housing evacuation system consisting of necessary piping and	x			
		1 - centrifugal blower and 2 - 5" I.D. x 6 ¹ / ₂ " alumina traps in fixed positions.	x			
		Instrumentation provided for automatic actuation of system.				
		5" I.D. x 30" withdrawal cylinders.	x			
B. K-27 Location						
	1. K-413 UF ₆ Withdrawal Facility	Special side withdrawals of UF ₆ from the cascade.				
	KSA-185 (N) KSA-108 (N) KS-452 KS-390 KS-366 KS-341 KS-330 KS-323	4 - 10" O.D. x 30" surge drums in K-631, which are part of the K-27 purge gas storage system, are used for storage of gaseous UF ₆ prior to withdrawal. (Temperature and pressure indicators and low-temperature alarms are provided.)	Gas phase operation			
B. K-27 Location						
	1. K-413 UF ₆ Withdrawal Facility					
		a. This facility has been considered only for U-235 enrichments up to 8.0%.				
	b. Each pump is operated on not more than 4.7 gal. of MFL oil.					
	c. UF ₆ withdrawals to geometrically unsafe containers on a safe mass basis are made with the following mass and enrichment controls in effect:					

NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY			OPERATIONAL CONTROLS
			DESIGN	CYL-SLAB VOL.	OPERATIONAL LIMITS MASS ASSAY CONC.	
B. K-27 Location (Cont.)						B. K-27 Location (Cont.)
1. K-413 UF ₆ Withdrawal Facility (Cont.)						<p>1. K-413 UF₆ Withdrawal Facility (Cont.)</p> <p>1) Border valves established and withdrawal system purged to the cascade and leak tested.</p> <p>2) U=235 enrichment analysis obtained prior to and during withdrawal.</p> <p>3) Weight checks made for mass control.</p> <p>4) Cascades continuously monitored for inleakage and inventory shift.</p> <p>In addition to these controls, the following controls are also established for withdrawals on a mass-limited moderation-controlled basis:</p> <p>5) Condenser temperature and pressure closely controlled to prevent HF condensation.</p> <p>6) Coolant levels checked at frequent intervals for infrequent leakage.</p> <p>d. 12" I.D., or smaller, cylinders are spaced at least 5° apart in the K-413 storage facility; 30" I.D. cylinders are temporarily stored in line not less than 3° end-to-end on the K-131 rail storage facility. (See B-3.)</p>

NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY			OPERATIONAL LIMITS ASSAY CONC.
			DESIGN CYL. SLAB VOL.	OPERATIONAL LIMITS MASS	ASSAY CONC.	
B. K-27 Location (Cont.)	1. K-413 UF ₆ Withdrawal Facility (Cont.)	30" I.D. x 81" withdrawal cylinders.*		X	X	
		A designated storage area west of and adjacent to the K-413 building is provided for cylinders up to 12" I.D.				
		(Steam hoists or steam baths are provided at K-131 to heat 30" I.D. cylinders for sampling, blending, or transfer operations. Both electric and steam units at K-601 are provided for smaller cylinders.)				
	2. K-631 UF ₆ Withdrawal Facility	Continuous removal from the bottom of the cascade of waste UF ₆ . KS-450	8 - 10" O.D. x 30" surge drums (22,307 cu. ft. total volume including piping) in an electrically heated housing. (Temperature and pressure indicators and low-temperature alarm provided.)	Gas phase operation		2. K-631 UF ₆ Withdrawal Facility
			2 - 3800 cu. centrifugal pumps.	Gas phase operation		a. Border valves which isolate the K-631 waste system from the K-631 purge system are buffered and stop-tagged.
			2 - 436 cuin. Elliott centrifugal pumps.	Gas phase operation	X	b. This facility is used for U-235 assays below 1%.
			2 - 8" I.D. x 8 1/2" condensers cooled by mixtures of C ₈ F ₁₆ and Butane-437, and equipped with low- and high-temperature alarms.	Gas phase operation		c. Cylinders are moved singly on the monorail and positioned horizontally only in specified withdrawal or storage locations.

* It is anticipated that this type cylinder, although formerly used on an infrequent basis for withdrawal of low enriched UF₆ under moderation-controlled conditions, will not be required for future operations at K-413.

NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL		METHOD SUMMARY		OPERATIONAL CONTROLS
			DESIGN	OPERATIONAL LIMITS	CYL.	SLAB VOL.	
3. K-27 Location (Cont.)							
2. K-631 UF ₆ Withdrawal Facility		7 = 50 cfm. Beach-Russ pumps. 2 = 4" I.D. x 8" tanks and 1 = 3½" x 7" tank (31.2 cu. ft. total volume) in electrically heated housings are provided for storage of cylinder purge gases. (Temperature and pressure indicators provided.)		Gas phase operation	x	x	
		A monitoring device is provided which continuously measures the U-235 enrichment of the waste UF ₆ stream.			x		x
		30" I.D. x 81" withdrawal cylinders.					x
		A monorail system is provided for the transfer of cylinders to the loading dock or storage facilities which consists of dollies (2 cylinders per dolly) on an external rail system.					x
3. K-131 UF ₆ Feed Facility	Vaporization of UF ₆ to the cascade.	4 = 8½" x 3½" x 8½" deep steam baths, each equipped with overflow lines to maintain a 5" slab depth and designed to hold 2 vertically positioned 30" I.D. x 81", 10" I.D. x 48", or 8" I.D. x 51" cylinders. (Baths drain to a common 4" I.D. condensate header containing a 10" I.D. x 3½" flash tank.)			x	x	x
		K-500 K-482 K-348					
		* This unit is in standby.					
		WCX-2299 (11-59)					

- 3. K-131 UF₆ Feed Facility*
 - a. Each 30" I.D. cylinder contains not more than a safe quantity.
 - b. Each 10" I.D. and 8" I.D. cylinder contains UF₆ at U-235 assays below 5% and 10%, respectively. See B-3-d.
 - c. Each incoming cylinder is weighed before it is placed in the bath.

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CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL DESIGN	METHOD SUMMARY		OPERATIONAL CONTROLS
				CYL.	SLAB VOL.	
B. K-27 Location (Cont.)				x	x	
3. K-131 UF₆ Feed Facility (Cont.)						
	5-gallon overflow collector containers.					
	Instrumentation is provided which, in the event of a UF ₆ release, actuates alarms and a cold-water cylinder freeze-down system, and also closes a solenoid valve in each condensate drain line and in the steam supply header and UF ₆ feed lines.					
	Manowall and dolly equipment for cylinder movement and storage same as B-2 except the dollies are each equipped to handle only 1 - 30" I.D. cylinder or 4 vertically positioned cylinders up to 10w I.D.					
	Vaporization of UF ₆ to the cascade.					
C. K-33 Location						
K-902-5 UF₆ Feed Facility						
	12 - vaporizer units, each equipped to heat 1 - 30" I.D. x 81", or smaller, feed cylinder with recirculating, electrically heated air and provided with instrumentation for temperature and pressure indication, control, and alarms.				x	
	Vaporization of UF ₆ to the cascade.					
D. K-33 Location						
K-902-5 UF₆ Feed Facility						
	1. Each cylinder is either filled at ORIGIN with not more than 5000 lbs. of UF ₆ at U=235 enrichment below 1.0% or filled at Paducah under conditions of low moderation with UF ₆ at a U=235 enrichment below 2%.					
	2. Each incoming cylinder is reweighed before it is placed in the vaporizer unit.					

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NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY			OPERATIONAL CONTROLS
			DESIGN CYL.	SLAB VOL.	OPERATIONAL LIMITS MASS	
1. K-33 Location (Cont.)	K-902-5 UF ₆ Feed Facility (Cont.)	These units are equipped with a UF ₆ release alarm system which, upon actuation, cuts off automatically the UF ₆ feed to the cascade. 2 - 50 ofm. Beach-Russ pumps.				C. K-33 Location (Cont.)
		1 - 5' O.D. x 17' tank (288 cu. ft.) enclosed in a steam-heated housing is provided for storage of cylinder purge gases. 26 - concrete cradles spaced along the east and west walls of the feed room are provided for cylinder storage.		X	X	K-902-5 UF ₆ Feed Facility (Cont.)
		Manorail system provided for movement of cylinders.				3. Cylinders are unloaded singly and in order from the trailer at the loading dock, moved singly on the monorail, and placed only in specified feed or storage locations.
						4. The use of steam for the removal of UF ₆ from the atmosphere in event of releases in the feed room was considered safe provided:
						a. Steam lines or hose nozzles are positioned so that steam is not sprayed directly on the feed cylinders.
						b. Containers which are safe for the U-235 enrichment concerned are used in clean-up operations.
						D. All Cascade Locations
						1. Special UF ₆ Withdrawal Operations
						a. Material withdrawn in either geometrically safe cylinders or in safe quantities based on U-235 assay and weight control.
						b. Cylinders are transferred singly, stored at least 10' from other uranium systems, individually spaced not less than 5' apart or handled in dollies.
						D. All Cascade Locations
						1. Special side withdrawals of UF ₆ or UF ₆ -C ₈ F ₁₆ mixtures from the cascade at any unit location.
						(Cascade cold trap facilities may also be used for UF ₆ or C ₈ F ₁₆ withdrawals by liquefying the condensed material and draining to collector cylinders.)
1. All Cascade Locations						
						1. Special UF ₆ Withdrawal Operations
						a. Material withdrawn in either geometrically safe cylinders or in safe quantities based on U-235 assay and weight control.
						b. Cylinders are transferred singly, stored at least 10' from other uranium systems, individually spaced not less than 5' apart or handled in dollies.

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NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY			OPERATIONAL CONTROLS
			DESIGN CYL. VOL.	OPERATIONAL LIMITS CYL. SLAB VOL.	ASSAY CONC.	
1. All Cascade Locations (Cont.)						D. All Cascade Locations (Cont.)
2. Special UF ₆ Feed Operations	Vaporization of UF ₆ to the cascade at specified gradient locations. KSA-137 (N) KS-497 KS-494 KS-484	<p>Portable and fixed units are used to vaporize cylinders of UF₆, primarily those obtained from recovery operations, through cell or line recorder piping.</p> <p>Portable units:</p> <p>1 - 14' x 8' dolly equipped with 4 electrically heated housings:</p> <p>Two housings are each equipped to handle 1 - 5" I.D. x 30" cylinder.</p> <p>Two housings are each equipped to handle cylinders up to 12" I.D.</p> <p>(The base area of each housing is such that a safe slab depth will not be exceeded in event of leakage of either type cylinder.)</p> <p>A hoist and monorail for cylinder handling.</p>			x	<p>2. Special UF₆ Feed Operations</p> <p>a. Electrically heated enclosures and infrared lamps are used to vaporize UF₆ from geometrically safe cylinders.</p> <p>b. The portable feed unit is used to heat only one type cylinder at a time.</p> <p>c. Cylinders are handled as in D-1-b.</p> <p>d. Controls previously specified for the portable purge equipment will be applicable. (See summary letter on cascade purge facilities, KSA-193.)</p>

NUCLEAR SAFETY SUMMARY

CASCADE FEED AND WITHDRAWAL FACILITIES

COMPONENT	FUNCTION	EQUIPMENT DESIGN	CONTROL METHOD SUMMARY			OPERATIONAL LIMITS	OPERATIONAL CONTROLS
			DESIGN	CYL. SLAB VOL.	MASS		
D. All Cascade Locations (Cont.) 2. Special UF ₆ Feed Operations (Cont.)		<p>is used for purging and evacuating the vaporization equipment.)</p> <p>Fixed units:</p> <p>Electrically heated enclosures. Direct heating with infrared lamps.</p>					